METHOD FOR OPERATING AN AIR CONDITIONING SYSTEM

BACKGROUND OF THE INVENTION

Field of the invention

[0002] The invention concerns a process for operating an air conditioning system in the passenger compartment of a motor vehicle of the generic type described in the pre-characterizing portion of Claim 1. The invention further concerns an air conditioning system for a motor vehicle according to the pre-characterizing portion of Claim 6.

Related Art of the Invention

[0003] Generic processes for operating air conditioning systems are known from the general state of the art. In normal operation the air conditioning system is operated in the recirculation mode, so that internal air is essentially recirculated within the passenger compartment of the motor vehicle and no fresh air is introduced. This has the advantage, in particular in the case of high ambient temperatures, that is in the cooling operation of the air conditioning system the air need not be cooled as strongly and the air conditioning system thus consumes less energy in the form of fuel. In order to nevertheless provide the vehicle occupants with fresh air, the air conditioning system is switched to fresh air mode at certain time intervals. Such a time control however takes no consideration as to the actual conditions in the passenger compartment of the motor vehicle, that is, for example, how many persons are within the vehicle and the air quality therein.

[0004] From DE 197 50 133 C2 a device for monitoring and controlling the CO_2 concentration in the passenger compartment of

a motor vehicle is known. Here, in complex and laborious manner, the concentration in the passenger compartment is determined and the excess CO_2-component is eliminated.

[0005] DE 197 20 293 C1 describes a device and a process for ventilation of a motor vehicle internal space depending upon corrosive gas. There, in the case that harmful substances or pollutants are detected in the outside air, the air conditioning system is switched from a normal fresh air mode operating condition to a recirculation mode.

[0006] A climate control system and a process for controlling thereof is known from DE 198 50 914 A1. Therein, in the cooling circulation, CO_2 is employed as the cooling agent (refrigerant) and a CO_2-sensor is located in the flow down stream of the heat exchanger, which sensor can detect possible damage of the heat exchanger and interrupt air supply to the passenger compartment of the motor vehicle in order to protect the health of the occupants.

SUMMARY OF THE INVENTION

[0007] It is the task of the present invention to provide a process for operating a climate control system in an internal space of a motor vehicle, in which the climate control can be operated in its normal condition for recirculating air for saving energy and, in the case that it is necessary, automatically be switched to fresh air mode. It is further the task of the invention to provide a climate control system for a motor vehicle suitable for carrying out this process.

[0008] In accordance with the invention this task is solved by the characterizing features set forth in Claim 1.

[0009] The climate control system switches, upon exceeding a predetermined CO_2-threshold value, which is measured in the passenger compartment of the motor vehicle, into the fresh air ventilation mode. The air quality in the passenger compartment is thus determined by the CO_2 content of the air, and by the switching into the fresh air ventilation mode upon reaching a predetermined threshold it is ensured that the internal space is always supplied in sufficient manner with oxygen-containing fresh air. The CO_2 content thus serves as indicator for the air quality in the passenger compartment of the motor vehicle.

[00010] By the conventional operation of the climate control system in the recirculation mode, in particular when cooled air is to be supplied to the passenger compartment, this results in a substantial savings in energy, since the recirculated cabin air requires substantially less cooling than the externally supplied, frequently warmer fresh air, and thus the compressor of the air conditioning system requires less energy. This advantage is however also noticeable in heating operation, since the internal air need not be heated as strongly as the externally supplied, cooler air.

[00011] By the inventive coupling of the switching between these two operating modes of the climate control system to the CO_2-level in the passenger compartment of the motor vehicle, a much more constant level of air quality is achievable than the prior time-controlled switching processes. When the motor

vehicle is essentially occupied by one person, the climate control system can generally be operated in recirculation mode for a substantially longer period of time than is the case with a time controlled system, which operates based on the presumption of an average, though not maximal, occupancy of the internal space.

[00012] A climate control system for a motor vehicle is disclosed in Claim 6. Therein a CO_2-sensor is provided in the passenger compartment of a motor vehicle, which triggers or actuates, upon exceeding a CO_2-threshold value, a switching of the control system from recirculation mode to fresh air mode. By means of this inventive climate control system the above described inventive process can be carried out in simple manner.

Brief Description of the Drawings

[00013] Advantageous embodiments and further developments of the invention can be seen from the dependent claims as well as from the following embodiment represented schematically in the drawings.

[00014] There is shown:

Fig. 1 a motor vehicle with an inventive climate control system; and

Fig. 2 an enlarged representation of the climate control system of Fig. 1

Detailed Description of the Invention

[00015] In Fig. 1 a motor vehicle **1** is shown, which includes a passenger compartment **2**, and engine compartment **3** and a trunk **4**. In the passenger compartment **2** there is located, in known manner, front seats **5** and back seats **6**, of which basically only a single one is represented. In front of the front seat **5** is the dashboard **7** with a steering wheel **8** and an ashtray **9**. On the front seat **5** there is provided a console **10**, into which an ashtray **11** reachable from the backseat **6** is incorporated.

[00016] In known manner a climate control system **12** is provided in the dashboard **7**, of which individual components are shown in detail in Fig. 2. Thus the climate control system **12** includes a blower **13**, with an evaporator **14** downstream in the flow of air, with the direction of flow shown by arrows. An intake **15** leads to the blower **13**, which after evaporator **14** branches into three lines **16**, **17** and **18**. From this, the first line **16** leads to the windshield **19** of the motor vehicle **1**, the second line **17** leads to the vent in the direction of the steering wheel **8** and the third line **18** opens into the foot space **20**, which is part of the passenger compartment **2**. In not described, however in known manner the occupants of the motor vehicle **1** can influence the channeling of air through the three lines **16**, **17** and **18** by means of appropriate actuating elements. The intake **15** to the blower **13** is supplied with air from the foot space **20** for recirculation and also by a fresh air line **22**. If the blower **13** intakes air essentially from the recirculation line **21**, then it is in the recirculation mode, since the internal space **2** is then essentially supplied by recirculated passenger compartment air. If the intake **15** intakes at least a

certain portion via the fresh air line **22**, than this case is referred to as the fresh air mode of the climate control system **12**. In the fresh air mode it is possible via the intake **15** to also intake a certain amount of recirculated internal air. For the switching between the recirculation line **21** and the fresh air line **22**, and in between the recirculation operation and fresh air operation of the climate control system **12**, a control element **23** is provided embodied in the present case as a flap or valve, which can be adjusted stepless using an adjustment device **24** embodied as a step motor. Conventionally the climate control system **12** is operated in the recirculation mode, since thereby in particular during supplying of cooler air in the passenger compartment **2** a substantial amount of energy can be saved. The fresh air amount is variable and depends upon the control of the control element **23**. As an alternative to the stepless adjustment it is of course also possible to switch between recirculation mode and fresh air mode, in which respectfully only either the recirculation line **21** or the fresh air line **22** is connected with the intake **15**.

[00017] The control over the climate control system **12** is exercised by a control device **25**, which as conventional is located in the engine compartment **3** or in the dashboard **7**, however, for space reasons, is shown in the figure outside of the motor vehicle **1**. Besides being connected with the adjustment device **24**, for the control of which it is provided, the control device **25** is further connected with a CO_2-sensor **26** located in one foot space **20** of the passenger compartment **2**, wherein of course any larger number of CO_2-sensors **26** can be provided. The CO_2-sensor 26 measures the CO_2 concentration in

the passenger compartment **2** of the motor vehicle **1** and, in the case of exceeding a certain predetermined CO_2 threshold value in the passenger compartment **2**, provides a signal to the control device **25**, so that this is switched from the previously existing recirculation mode to the fresh air mode. For this, essentially the control element **23** must be moved by means of the actuator or adjustment device **24** from the fresh air line **22** in the direction of the recirculation line **21**. In this manner the mode of operation of the climate control system **12** is dependent upon the CO_2 content in the passenger compartment **2** of the motor vehicle **1** and it is ensured that the occupants in the case of exceeding a predetermined CO_2-threshold value are supplied with fresh air. It has been found to be particularly advantageous when this CO_2-threshold value is approximately 800 ppm. Of course, the CO_2-sensor **26** or, as the case may be, the control device **25**, can be set to other CO_2-threshold values, when this is considered useful or necessary. In certain cases, for the switching between recirculation mode and fresh air mode, the quality or as the case may be composition of the environmental air can also be taken into consideration.

[00018] The control device **25** is further connected with two sensors **27** and **28**, which are associated with the ashtrays **9** and **11**. As soon as the corresponding ashtrays **9** or as the case may be **11** are opened, this is detected by the sensor **27** or as the case may be **28** and relayed to the control device **25**, which subsequently switches via the adjustment device (actuator) **24** and the control element **23** of the climate control system **12** as described above into the fresh air mode. Such a supplemental control of the switching of the climate control system **12** from

recirculation mode into fresh air mode in response to the ashtrays **9** and **11** is useful, since during smoking increased amounts of CO, NO_x, etc. are produced and thus an earlier switching into the fresh air mode is desirable. Of course, in connection therewith, additional ashtrays can be provided with appropriate sensors. Supplementally or alternatively to the sensors **27** and **28**, which detect to the opening of the ashtrays **9** and **11**, other sensors can also be provided in the passenger compartment **2**, with which it can be determined whether smoking is taking place in the internal space **2** of the motor vehicle **1**. It can be advantageous to switch completely to the fresh air mode if one of the sensors **27** or **28** is activated. The sensors **27** and **28** can of course also be activated independent of the CO_2 content measured by the CO_2-sensors **26**, and switch the climate control **12** into the fresh air mode.

[00019] In the described process for operating the climate control system **12** it can be further provided, that during switching into the fresh air mode the fresh air is conveyed primarily along the third line **18** into the foot space **20**. Since CO_2 is heavier than environmental air, CO_2 collects primarily in the lower area of the passenger compartment **2** and is displaced more quickly from the internal space **2** by the introduced fresh air, for example via not shown openings leading from the passenger compartment **2** into the trunk space **4**.

[00020] Since CO_2 is heavier than room air, it is alternatively also conceivable to convey the fresh air via the lines **16** and/or **17** in such a manner that is blown into the face area, without mixing with the CO_2 in the foot space **20**.

[00021] The CO_2-sensor **26** is also very effective and other sensors can be dispensed with in the case that the cooling agent for the evaporator **14** is CO_2. Thereby a possible leakage of the evaporator **14** can be very quickly detected and the climate control system **12** can be switched off and the blower **13**, following switching of the control element **24** to fresh air operation, can possibly also be switched to an elevated or as the case may be maximal blower setting, so that a safety device is provided for the occupants by the CO_2-sensor **26**, the control device **25** and the control element **23**. In order to accomplish this switching off by the control system **12**, as shown in Fig. 2, the evaporator **14** can be provided on the pressure side with an expansion valve **29**, which separates the evaporator **14** from the circulation, and which blocks it when the CO_2-sensor **26** detects a CO_2 leakage, or when the CO_2-sensor **26** or as the case may be a control signal is lost, for example following an accident. In Fig. 2 there is further shown a compressor **31** connected via a line **30** with the evaporator **14**, in the supply line **32** of which a vacuum valve **33** is provided. This valve **33** serves to switch off the compressor **31** in cases of possible leakage of the evaporator **14**.